L Number	Hits	Search Text	DB	Time stamp
1	1447	(MR or magneto$9) near15 (cap or protect$3)	USPAT	2002/06/14 17:47
2	8869	(MR or magneto$9) near15 (magnetic near2 field)	USPAT	2002/06/14 17:57
3	822	((MR or magneto$9) near15 (cap or protect$3)) and ((MR or magneto$9) near15 (magnetic near2 field))	USPAT	2002/06/14 17:57
4	104	360/322.ccls.	USPAT	2002/06/14 17:57
5	18	(((MR or magneto$9) near15 (cap or protect$3)) and ((MR or magneto$9) near15 (magnetic near2 field))) and 360/322.ccls.	USPAT	2002/06/14 18:03
6	10058	magnetic near3 region	USPAT	2002/06/14 18:04
7	19195	oxid$4 near3 conduct$4	USPAT	2002/06/14 18:05
8	121	cap near15 (oxid$4 near3 conduct$4)	USPAT	2002/06/14 18:06
9	72	((MR or magneto$9) near15 (magnetic near2 field)) and 360/322.ccls.	USPAT	2002/06/14 18:06
10	0	(magnetic near3 region) and (oxid$4 near3 conduct$4) and (cap near15 (oxid$4 near3 conduct$4)) and (((MR or magneto$9) near15 (magnetic near2 field)) and 360/322.ccls.)	USPAT	2002/06/14 18:06
11	0	(magnetic near3 region) and (oxid$4 near3 conduct$4) and (cap near15 (oxid$4 near3 conduct$4))	USPAT	2002/06/14 18:06
12	109	(magnetic near3 region) and (oxid$4 near3 conduct$4)	USPAT	2002/06/14 18:06
13	1	360/322.ccls. and ((magnetic near3 region) and (oxid$4 near3 conduct$4))	USPAT	2002/06/14 18:08
14	73	360/322.ccls. and "18"	USPAT	2002/06/14 18:09
15	15	((MR or magneto$9) near15 (cap or protect$3)) and (360/322.ccls. and "18")	USPAT	2002/06/14 18:08
16	0	360/322.ccls. and (cap near15 (oxid$4 near3 conduct$4))	USPAT	2002/06/14 18:09
17	0	((MR or magneto$9) near15 (cap or protect$3)) and (cap near15 (oxid$4 near3 conduct$4))	USPAT	2002/06/14 18:10
18	0	((MR or magneto$9) near15 (magnetic near2 field)) and (cap near15 (oxid$4 near3 conduct$4))	USPAT	2002/06/14 18:10
19	0	360/322.ccls. and (cap near15 (oxid$4 near3 conduct$4))	USPAT	2002/06/14 18:10
20	0	360/322.ccls. and (cap near15 (oxid$4 near3 conduct$4))	USPAT	2002/06/14 18:10
21	3	360/322.ccls. and (oxid$4 near3 conduct$4)	USPAT	2002/06/14 18:11
22	20	360/322.ccls. and ((MR or magneto$9) near15 (cap or protect$3))	USPAT	2002/06/14 18:11
23	0	(magnetic near3 region) and (360/322.ccls. and (cap near15 (oxid$4 near3 conduct$4)))	USPAT	2002/06/14 18:11
24	0	(oxid$4 near3 conduct$4) and (360/322.ccls. and (cap near15 (oxid$4 near3 conduct$4)))	USPAT	2002/06/14 18:12
25	5834	cap near3 pin$5	USPAT	2002/06/14 18:14
26	0	(360/322.ccls. and ((MR or magneto$9) near15 (cap or protect$3))) and (cap near3 pin$5)	USPAT	2002/06/14 18:14
27	0	360/322.ccls. and (cap near3 pin$5)	USPAT	2002/06/14 18:15
28	0	(cap near15 (oxid$4 near3 conduct$4)) and (cap near3 pin$5)	USPAT	2002/06/14 18:15
29	2	((((MR or magneto$9) near15 (cap or protect$3)) and ((MR or magneto$9) near15 (magnetic near2 field))) and 360/322.ccls.) and (magnetic near3 region)	USPAT	2002/06/14 18:16

DOCUMENT-IDENTIFIER: US 5883764 A
TITLE: Magnetoresistive sensor having multi-layered refractory metal conductor leads

---------- KWIC ---------

BSPR:
In high capacity disk drives, magnetoresistive read sensors, commonly referred to as MR heads, are the prevailing read sensors because of their capability to read data from a surface of a disk at greater linear densities than thin film inductive heads. An **MR sensor detects a magnetic field through the change in the resistance of its MR** sensing layer (also referred to as an "MR element") as a function of the strength and direction of the magnetic flux being sensed by the MR layer.

BSPR:
The conventional MR sensor operates on the basis of the anisotropic magnetoresistive (AMR) effect in which the MR element resistance varies as the square of the cosine of the angle between the magnetization of the MR element and the direction of sense current flow through the MR element. Recorded data can be read from a magnetic medium because the external **magnetic field from the recorded magnetic medium (the signal field) causes a change in the direction of magnetization in the MR** element, which in turn causes a change in resistance in the MR element and a corresponding change in the sensed current or voltage.

BSPR:
FIG. 1 shows a prior art AMR sensor 100 comprising end regions 104 and 106 separated by a central region 102. Soft film 112, spacer layer 114, **MR layer 110 and cap** layer 116 are formed in the central region 102. Hard bias layers 130 and 135 formed in the end regions 104 and 106, respectively, provide longitudinal bias for the MR layer 110. Leads 140 and 145 formed over hard bias layers 130 and 135, respectively, provide electrical connections for the flow of the sensing current I.sub.S from a current source 160 to the MR sensor 100. Sensing means 170 connected to leads 140 and 145 sense the change in the resistance due to changes induced in the **MR layer 110 by the external magnetic field** (e.g., field generated by a data bit stored on a disk).

DEPR:
FIG. 5 is an ABS view of a second embodiment of the present invention showing an AMR sensor 500 manufactured with the improved conductance multilayer lead

structure of the preferred embodiment. AMR sensor 500 comprises end regions 504 and 506 separated by a central region 502. An Ni--Fe MR layer 510 is separated from a bias layer 520 by a non-magnetic spacer layer 515. **Cap layer 508, MR** layer 510, spacer layer 515, and bias layer 520 are all formed in the central region 502. Hard bias layers 530 and 535 formed in the end regions 504 and 506, respectively, provide longitudinal bias for the MR layer 510. Leads 540 and 545 formed over hard bias layers 530 and 535, respectively, provide electrical connections for the flow of the sensing current I.sub.S from a current source 560 to the MR sensor 500. Sensing means 570 connected to leads 540 and 545 sense the change in the resistance induced in the **MR layer 510 by the external magnetic field**.

CLPX:
means coupled between the conductive lead structures for detecting resistance changes in the **magnetoresistive material responsive to magnetic fields representative of data bits recorded in the magnetic storage medium intercepted by the layer of magnetoresistive** material.

CCOR:
360/322

DOCUMENT-IDENTIFIER: US 5946167 A
TITLE: Magnetoresistive sensor having lead and/or bias layer structure contributing to a narrow gap

---------- KWIC ---------

BSPR:
For the above reasons, it was considered to be a difficult challenge to precisely define in a shape corresponding to a reduced-size gap. It was also considered to be a difficult challenge to prevent the center of a flow of a sensing current from being different between the center **region and the edge region of the magnetic** field response portion.

DEPR:
There are no particular restrictions on the specific material to be used for the etching mask 21, and various materials such as resist, carbon, silicon oxide, aluminum oxide, silicon nitride, or aluminum nitride may be employed. When a material other than a resist is employed, for example, a silicon oxide film, a patterning resist of the desired shape of the leads is formed after continuous deposition of silicon **oxide film and good-conductor** film 17' on the MR film 15, and the silicon oxide film is patterned using the patterning resist as a mask. Patterning of the good-conductor film 17' is then performed using this patterned silicon oxide film as mask. If the film thickness of the silicon oxide film is set such that the silicon oxide film that was used as the mask has disappeared by the time the lead patterning is completed, deposition of the upper-side playback magnetic gap film 18 can be commenced immediately after completion of the lead patterning. The number of times the MR film 15 is exposed to the wet process can thereby be reduced. Therefore, an anti-ferromagnetic film included in the MR film such as FeMn alloy of inferior corrosion resistance may be easily used.

CCOR:
360/322

DOCUMENT-IDENTIFIER: US 5491600 A
TITLE: Multi-layer conductor leads in a magnetoresistive head

---------- KWIC ---------

BSPR:
A magnetic transducer, often referred to as a magnetoresistive (MR) sensor head, is utilized as part of a magnetic data storage and recording media. An MR sensor is capable of reading data from a magnetic surface at high linear densities. It detects **magnetic field signals through the resistance changes of a read element made from a magnetoresistive** material as a function of the amount and direction of magnetic flux being sensed by the element.

DEPR:
A specific embodiment of one type of magnetoresistive read transducer assembly will be described briefly in conjunction with FIG. 2. The magnetic read head utilizes a magnetoresistive (MR) sensor 30 produced on a suitable substrate 31. The MR sensor 30 can be divided into two regions, the central active region 32, where actual sensing of data is accomplished, and passive end regions 34. The distance between the inner edges of conductive lead structures 38 and 40 comprise the portion of the active region 32 over which the output signal is sensed. The two regions, end region 34 and active region 32, should be biased in different manners with longitudinal bias only in the end regions 34 and transverse bias in the active region 32. The longitudinal bias in the end regions 34 is produced by bias layer 35. Bias layer 35 may comprise either an antiferromagnetic material or a hard magnetic material such as CoPtCr. The resultant unidirectional anisotropy develops by means of exchange coupling across the interface between the MR layer and the hard bias layer and produces a shift of the MH loop of the MR layer which is usually called the longitudinal exchange bias field. This bias field extends parallel to the surface of the magnetic media and parallel to the lengthwise direction of the MR sensor. The function of the longitudinal bias field is to suppress Barkhausen noise, which originates from multi-domain activities in the MR sensor. The transverse bias in the active region 32 is produced by a soft magnetic film layer 37 which is separated from the MR layer 36 by a thin non-magnetic spacer layer 39 whose purpose is to prevent, within the active central **region, a magnetic** exchange coupling between the MR layer 36 and the soft magnetic bias layer 37. Both bias layers are formed on top of insulator layer 41, composed of an oxidized metal, and shield layer 33, composed of a magnetic material.

DEPR:
With reference now to FIG. 3, an output signal can be coupled out to sensing means 43, with the aid of conductive lead structures 38 and 40 which are electrically connected to the MR sensor 30. The voltage (or current) signal enables the sensing means 43 to determine the resistance changes in the active **region 32 as a function of the magnetic fields which are intercepted by the MR** sensor 30 from previously recorded data on a magnetic medium, for example. A bias source 45 is also connected to conductive lead structures 38 and 40 to supply a bias current which, in conjunction with soft magnetic bias film layer 37, as seen in FIG. 2, produces the transverse bias in the active regions 32, as is known in the art. Typically, sensing means 43 and bias source 45 may be incorporated in the read/write channel circuitry 25 (as shown in FIG. 1).

DEPR:
Overlaying spacer layer 70 is MR layer 75. MR layer 75 is made of a magnetoresistive material such as nickel-iron (NiFe). **Cap layer 80 overlays MR layer 75 to provide protection**. Capping layer 80 is typically comprised of a refractory metal such as tantalum.

DEPR:
FIG. 6 depicts the MR sensor after the etching process has been completed. The layers lying under photoresist 90 have been protected during the etching process and remain intact. The portions of soft film layer 65, spacer layer 70, **MR layer 75, and capping layer 80 not protected** by the photoresist during the etching process have been removed. Insulator layer 60 and shield layer 55 are not affected by the etching process.

CLPV:
means coupled between the first and second multilayered conductive lead structures for detecting resistance changes in the **magnetoresistive material responsive to magnetic fields representative of data bits recorded in the magnetic storage medium intercepted by the layer of magnetoresistive** material.

CCOR:
360/322

DOCUMENT-IDENTIFIER: US 4821012 A
TITLE: Magnetoresistive element

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ABPL:
A shunt biased **magnetoresistive element includes a sensor part sensitive to an external magnetic field** and a pair of leads (electrodes) in contact with the sensor part. The width (W) of the contact between the sensor part and each of the leads is selected to be equal to or larger than the width (L) of the sensor part. The MR element further includes a center tap having a width (W') selected to be two or more times as large as the width (L) of the sensor part, because the quantity of current flowing through the center tap is two times as large as that flowing through each of the end leads.

BSPR:
A magnetic head employing an MR film (which head will be abbreviated hereinafter as an MR head) is now being widely used. In the case of such an **MR head, it is necessary to externally apply a predetermined magnetic field in order to improve the sensitivity and linearity of the MR** film. This **magnetic field is called a bias magnetic field, and various methods including (1) a method of disposing a permanent magnet in the neighborhood of the MR** film, (2) a method of disposing a conductor film in contact with the MR film, and (3) a method of disposing a soft magnetic film in the neighborhood of the MR film, have been proposed hitherto. Especially, the method described in (2) is called a shunt biasing method, and such a shunt biasing method is disclosed in, for example, U.S. Pat. No. 3,967,368. This U.S. patent shows an arrangement as shown in FIG. 1. Referring to FIG. 1, both a sensor part 10 exhibiting a **magnetoresistive effect in response to an externally applied magnetic field** and leads 20 and 25 supplying a predetermined current to the sensor part 10 to produce a bias **magnetic field and deriving a change in the resistance of the sensor part 10 as a voltage change are made of an MR** film and a conductor film. However, in the structure of the shunt biased MR element shown in FIG. 1, no consideration was given to the widths W and W' of the leads 20 and 25 at the surface of the shunt biased MR element remote from the surface 15 facing a recording medium. Further, the relation between the sensor part 10 and the leads 20, 25 was not also considered. As a result, a uniform current did not always flow through the sensor part 10, and the desired bias **magnetic field could not be applied to the MR** film.

BSPR:
It is an object of the present invention to clarify the dimensional relation between the sensor part and the leads and to provide an **MR element structure which ensures uniform flow of current through the sensor part so as to produce the desired appropriate bias magnetic field**.

DRPR:
FIG. 7 shows the distribution of a bias and a signal **magnetic field in the MR** film relative to the distribution of the bias current.

DRPR:
FIG. 8 shows the relation between the resistance change of the **MR film and the intensity of the externally applied magnetic field**.

DEPR:
The value of W/L should not be excessively large when a multi-track structure is provided by arranging a plurality of MR elements in side-by-side relation. This is because the value of M/L determines the lower limit of the track pitch, and it is difficult to increase the track density. While current does not flow in the direction of the track width T in the hatched regions 35 (FIG. 1) defined between the two end leads 20 and the sensor part 10, which makes the bias for the MR element inproper and thus makes the sensitivity of the MR element low, when the MR element is used to form a magnetic head for overwriting information on a magnetic recording medium such as a magnetic tape, and when the magnetic head deviates from a recorded track, the MR film in the hatched regions 35 will be magnetized due to magnetization in the previously recorded track (because the hatched **regions also have MR films being magnetic** films) and this magnetization transferred to the sensor part 10 is read or reproduced as noise which degrades the S/N (signal-to-noise) ratio of the magnetic head. Therefore, it is undesirable to unnecessarily increase the value of W/L, and this value of W/L is generally preferably selected to be about 2 to 2.5 at the maximum.

DEPR:
An embodiment of the present invention will now be described. FIG. 6 is a schematic perspective view of a shunt biased MR head embodying the present invention. The method of making the shunt biased MR head shown in FIG. 6 is basically the same as that disclosed in U.S. Pat. No. 3,967,368. First, a film 110 of an electrical insulator such as alumina is deposited by sputtering on a base 100 of ferrite. A film 120 of an electrical conductor such as titanium is evaporated on the insulator film 110, and an MR film 130 is then formed on the conductor film 120 in such a relation that its magnetic easy axis extends in a direction as shown by the black arrow, in FIG. 6. A film of an

electrical insulator such as alumina (not shown) is then deposited on the **MR film 130 as a protective layer, and lead-out conductors are provided to form an MR** element. A block 140 formed of the same material as that of the base 100 or of a film of a magnetic material such as permalloy is then mounted on the MR element to complete the MR head. This block 100 constitutes a magnetic circuit together with the base 100 and acts as a shield, so that the MR head can operate with a high resolution.

DEPR:
The above advantage will be described with reference to FIG. 7. In the graph of FIG. 7, the horizontal axis represents the position in the **MR film as measured in the direction of the width L of the MR film, and the vertical axis represents the intensity of a bias and a signal magnetic field**. The curve .circle.1 indicates the distribution of the signal magnetic field. The curve .circle.2 indicates the distribution of the bias magnetic field when the current flow in the conductor layer is uniform. The curve .circle.3 indicates the distribution of the bias magnetic field when the current flow in the conductor layer is locally concentrated in the inside portion of the conductor layer. It will be seen from comparison between the bias **magnetic field distribution curves .circle.2 and .circle.3 shown in FIG. 7 that the bias magnetic field is more intense at the MR film portion which faces the magnetic tape and where the signal magnetic field** is intense. FIG. 8 shows changes in the resistance of the **MR film relative to the intensity of the bias magnetic field so as to explain the relation between the input and the output of the MR** head. It will thus be seen in FIG. 8 that a signal **magnetic field having a higher intensity induces a greater change in the resistance of the MR film in the presence of an appropriate bias magnetic field, and, as a result, the output of the MR** head increases.

DEPR:
It will be understood from the foregoing description of the present invention that, because of the uniform flow of current through a sensor part of a shunt biased **MR element, a bias magnetic field appropriate for the MR** element can be applied so that an MR head can generate a higher reproduced signal output, and the linearity of the output can be improved. Further, because the current does not locally concentrate in the sensor part and leads of the MR element, the life time of the MR element can be extended.

CLPR:
1. A magnetoresistive element comprising a sensor part including a magnetoresistive film and a conductor film formed on one side of said **magnetoresistive film to make electrical contact therewith, said magnetoresistive film exhibiting a magnetoresistive effect by sensing an**

external magnetic field, and a first lead and a second lead extending from the both ends respectively of said sensor part to derive any change in the resistance of said sensor part as a corresponding voltage change, the width (W) of each of said leads in contact with said sensor part being selected relative to the width (L) of said sensor part to satisfy the relation L.ltoreq.W and to also satisfy the relation W.ltoreq.2.5 L.

CLPR:
2. A magnetoresistive element comprising a sensor part including a magnetoresistive film and a conductor film formed on one side of said **magnetoresistive film to make electrical contact therewith, said magnetoresistive film exhibiting a magnetoresistive effect by sensing an external magnetic field,** and a first lead and a second lead extending from the both ends respectively of said sensor part to derive any change in the resistance of said sensor part as a corresponding voltage change, the width (W) of each of said leads in contact with said sensor part being selected relative to the width (L) of said sensor part to satisfy the relation L.ltoreq.W, and further comprising a third lead extending from the middle position of said sensor part to derive said resistance change of said sensor part, the width (W') of said third lead in contact with said sensor part being selected to satisfy the relation 2L.ltoreq.W'.

CLPR:
4. A **magnetoresistive element comprising a sensor part to be disposed above a magnetic recording medium and including a magnetoresistive film for detecting a change in a magnetic field** of said recording medium, and a first lead and a second lead extending from the both ends respectively of said sensor part in a direction away from said recording medium to derive any change in the resistance of said sensor part as a corresponding voltage change, the width (W) of each of said leads, when sectioned by a plane distant by the width (L) of said sensor part from the surface of said sensor part facing said recording medium, is selected to satisfy the relation L.ltoreq.W, and to also satisfy the relation W.ltoreq.2L.

CLPR:
5. A **magnetoresistive element comprising a sensor part to be disposed above a magnetic recording medium and including a magnetoresistive film for detecting a change in a magnetic field** of said recording medium, and a first lead and a second lead extending from the both ends of said sensor part in a direction away from said recording medium to derive any change in the resistance of said sensor part as a corresponding voltage change, the width (W) of each of said leads, when sectioned by a plane distant by the width (L) of said sensor part from the surface of said sensor part facing said recording medium, is selected

to satisfy the relation L.ltoreq.W, and further comprising a third lead extending from the middle position of said sensor part in a direction away from said recording medium to derive said resistance change of said sensor part, the width (W') of said third lead, when sectioned by the plane distant by the width (L) of said sensor part from the surface of said sensor part facing said recording medium, is selected to satisfy the relation 2L.ltoreq.W'.

CCXR:
360/322